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MONDAY, DECEMBER 11TH, 1854.

LIEUT.-COL. LARCOM, F.R.S., VICE-PRESIDENT, in the Chair.

THE following account of a series of analyses, instituted to determine the relative quantities of potash and soda in the felspar of the Dublin and Wicklow granite, was read by the Rev. Joseph A. Galbraith, Erasmus Smith's Professor of Natural and Experimental Philosophy in the University of Dublin.

"Granite is a rock which generally consists of three constituents, namely, quartz, mica, and felspar, in varying proportions. The first of these, quartz or silex, is a mineral of invariable composition; the second, mica, is a mineral of complex constitution, admitting of considerable varieties both in its chemical composition and in its physical properties. In some granites it is replaced either wholly or in part by hornblende; as, for instance, in the syenite of Egypt, and the granites of the county of Galway. In some by talc, as in the Protogene of Mont Blanc, and in parts of Cornwall; and occasionally by the remarkable hydrated mineral chlorite, as in the granite rocks in the vicinity of Liskeard. The third constituent, felspar, is a mineral of very definite composition, admitting of no important chemical variety, except in its alkaline constituents. The nature and extent of this variety will be best understood by comparing together the following theoretical analyses, which are extreme cases:—

Composition of Typical Orthose, or Potash Felspar.		Composition of Typical Albite, or Soda-Felspar.	
Silex,	64·81	Silex,	68·74
Alumina,	18·38	Alumina,	19·50
Potash,	16·81	Soda,	11·76
	100·00		100·00

One is calculated on the hypothesis that the mineral contains no other alkali than potash, the other on the hypothesis that it contains soda only.

"The fact is, that we rarely, if ever, find a felspar whose composition coincides altogether with either of these calculated analyses, both the alkalies being, we may say, always present, but in almost every case (with a few exceptions specified in the standard works on mineralogy) one of them is found to preponderate greatly over the other, and accordingly the name orthose, or potash felspar, has been generally assigned to those specimens whose chemical character is defined by a great excess of potash, while the name albite, or soda felspar, has been given to those in which soda exists in great excess. There are other distinctions founded on crystallographic form, which at present I purposely abstain from dwelling upon, my present object being to lay before the Academy the results of the chemical examinations I have made of this important constituent of our granite rocks.

"The ordinary felspar occurring in granite is orthose or potash felspar, and in those cases in which this mineral is replaced or accompanied by albite, the granite is designated albitic. In Ireland we have a very interesting case of this description in the granite of the Mourne mountains. And accordingly, we frequently find it cited both by English and foreign writers on geology as a typical locality. The granite district which stretches in a south-westerly direction from Williamstown, in the county of Dublin, through the county of Wicklow, to Poull Mounty, in the neighbourhood of New Ross, has been, up to a very late period, supposed to furnish that variety of felspar only which is called orthose or potash-felspar. Any statement, therefore, to the contrary, if made on competent authority, must naturally attract attention; and any amount of pains or trouble may be said to be well expended if we can arrive at the determination of a question of such high interest to the geological inquirer.

" A statement of this nature, made by a Member of this Academy about two years ago, first drew my attention to the subject. Many circumstances have contributed to prevent me from carrying on the investigation as rapidly as I could have wished. Nor have I even yet completed the series which I originally projected, as I had determined not to rest satisfied until I had fairly examined the whole range of the Dublin and Wicklow mountains from Killiney to New Ross. Although I have not completed my series, I have, notwithstanding, examined that portion of the district which extends from the quarries of Dalkey to the mountain of Lug-na-quilla, and which, so far as Sir Robert Kane's statement is concerned, is the most important; and accordingly, I do not hesitate to lay before the Academy, as a first contribution towards a complete chemical investigation of this subject, the results of seven analyses of felspars taken from different localities in these mountains, and of founding upon them my dissent from the statement made by Sir Robert Kane, viz., 'that the felspar of our Dublin granites is upon the whole a soda or albitic felspar.

" These words occur in the concluding statement of a communication made to the Academy in the month of January, 1853, in which he 'brought under the notice of the Academy the results of the analysis of the waters of the streams which descend from the side of the Dublin mountains, such as the Three Rock Mountain, with a view to illustrate the process of decomposition of the granite masses of these rocks, and the conversion of the felspathic elements into clays adapted to ceramic manufactures.'

" In this paper we find two analyses, one that of a water taken from a stream running down the side of the Three Rock Mountain at a place called Ticknock; the other of a water collected from a hole in a quarry, excavated for the purpose of cutting out the substance so well known in this city as freestone. From the residues of both these waters after evaporation, the soda greatly preponderates over the potash, in the former in the ratio of 6 : 1; in the latter in the ratio of 10 : 1. From these facts he drawn an inference which, from its importance, I shall quote from the Proceedings in his own words:—

"'The analysis of these waters have placed in view another fact of much interest in regard to the geognostic character of the granite of the Dublin mountains. In the water there were found both potash and soda, but the latter in very great excess. This indicates that the felspar of our Dublin granite is upon the whole a soda or albitic felspar, although in particular spots orthose, or potash felspar, may be found. The fact has been also verified by a great number of analyses of specimens of granites from various parts of the great mass which extends from Dublin into the county of Wicklow. In all the analyses made, which included both ordinary granites and elvan or granite porphyries, both potash and soda were present, and the latter almost always so preponderant as to lead to the conclusion that the potash should in most cases be considered to belong to the mica which the granite contained, and that the felspar was almost exclusively an albitic or soda felspar, containing only in some cases a small quantity of replacing potash.'—*Proceedings*, vol. v. p. 351, January 10, 1853.

"A statement so precise as this, and at the same time so novel, naturally called forth discussion; and accordingly I find that Dr. Apjohn, who was present when the communication was made, expressed surprise at the fact, which he then learned for the first time, namely, that potash was either absent from the Dublin felspar, or, at most, only casually present, and then only in insignificant quantities; that Sir Robert Kane's communication stated as a principal fact that which was wholly contrary to his experience. Dr. Apjohn considered this question one of such importance that he made it the subject of a communication, which he shortly after laid before the Academy, in which he brought forward a number of facts which appeared to him irreconcilable with the conclusion arrived at by Sir Robert Kane, namely, that in the granite of the Dublin and Wicklow granites soda existed in great excess, and that only in some cases they contain a small quantity of replacing potash; and in which he stated his opinion that we could not rest such a conclusion on an argument which appeared to him too circuitous, especially when the investigation might be conducted in a simpler and more direct manner than that pursued by Sir Robert Kane, namely, the analysis of surface water, and the examination of rock specimens taken from the district; and that he did not think that mineralogists would feel themselves safe in adopting Sir Robert Kane's conclusions, until it was supported by the results of experiments made directly on the felspars themselves.

"Feeling the importance of this suggestion, it occurred to me that good service might be done to the sciences, both of mineralogy and geology, if I were to undertake the chemical examination of the minerals whose character was called in question, in order, if possible, to arrive at the determination of such an interesting question. And that I might not fall on these 'particular spots where orthose or potash-felspar was to be found,' I cast my eye over the map of Dublin and its adjacent county, and selected a number of localities pretty evenly distributed over the range commencing at Dalkey and extending as far as Glenmalur, situated on the flanks of Lugna-quilla, which is about thirty-six miles from Dublin.

"The results of these analyses I beg to lay before you. The distances of the localities from which the specimens were taken may be stated as follows:—

From Dalkey to Three Rock Mountain, ... 5 miles.
,, Three Rock Mountain to Lough Bray, . 5 ,,
,, Lough Bray to Lough Dan, ... 8 ,,
,, Lough Dan to Glenmacanass, ... 2 ,,
,, Glenmacanass to Glendalough, ... 5 ,,
,, Glendalough to Glenmalur, ... 2 ,,

DALKEY QUARRIES.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	64·00	1·412		4·01
Alumina,	18·11	0·352		1·00
Magnesia,	0·57	0·028	0·396	1·13
Lime,	Trace,	0·000		
Potash,	12·73	0·271		
Soda,	3·00	0·097		
Loss by ignition,	0·55			
	98·96			

Sp. gr. = 2·540.

THREE-ROCK MOUNTAIN.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	65·40	1·444		4·19
Alumina,	17·71	0·344		1·00
Magnesia,	1·77	0·088	0·420	1·22
Lime,	Trace,	0·000		
Potash,	10·68	0·227		
Soda,	3·26	0·105		
Loss by ignition,	0·69			
	99·51			

Sp. gr. = 2·562.

LOUGH BRAY.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	65·44	1·444		4·04
Alumina,	18·36	0·357		1·00
Magnesia,	0·00	0·000	0·388	1·08
Lime,	0·80	0·038		
Potash,	12·34	0·262		
Soda,	2·73	0·088		
Loss by ignition,	0·52			
	100·19			

Sp. gr. = 2·554.

LOUGH DAN.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	65·05	1·436		4·16
Alumina,	17·72	0·345		1·00
Magnesia,	Trace,	0·000	0·381	1·10
Lime,	0·23	0·008		
Potash,	13·42	0·285		
Soda,	2·75	0·088		
Loss by ignition,	0·36			
	99·53			

Sp. gr. = 2·559.

GLENMACANASS.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	64·19	1·417		3·96
Alumina,	18·39	0·358		1·00
Magnesia,	0·34	0·017	0·379	1·05
Lime,	0·70	0·025		
Potash,	11·39	0·242		
Soda,	2·95	0·095		
Loss by ignition,	0·58			
	98·54			

Sp. gr. = 2·553.

GLENDALOUGH.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	63·60	1·404		3·83
Alumina,	18·84	0·366		1·00
Magnesia,	0·40	0·020	0·385	1·05
Lime,	Trace,	0·000		
Potash,	14·33	0·305		
Soda,	1·92	0·060		
Loss by ignition,	0·60			
	99·69			

Sp. gr. = 2·453.

GLENMALUR.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	64·48	1·423		3·84
Alumina,	19·04	0·370		1·00
Magnesia,	1·02	0·051	0·364	0·98
Lime,	Trace,	0·000		
Potash,	10·74	0·228		
Soda,	2·64	0·085		
Loss by ignition,	0·78			
	98·70			

Sp. gr. = 2·560.

"On examining these analyses, it will be found that not even in a single instance do they deviate from the well-known composition of orthose or potash felspar. The average ratio of potash to soda from these analyses is 9 : 2; the greatest amount of soda present being 3¼ per cent., which is found in the specimen taken from the Three Rock Mountain, which quantity, although relatively great, is less than one-third of the potash in the same specimen.

"We find, from the extract which I have read, that Sir Robert Kane was unwilling to found a statement as to the nature of our granites so important as this on an inference drawn from the analysis of a water taken from the locality; for he affirms that his conclusion is verified by a number of analyses of granite specimens taken from various parts of the range, and that in all these specimens so great was the excess of the soda over the potash, that he felt himself warranted in drawing the conclusion that the potash should, in most cases, be considered as belonging to the mica, and that the felspar was almost exclusively an albitic or soda felspar, containing only in some cases a small quantity of replacing potash.

"On referring to the analyses which I now lay before you, I think I am warranted in the statement, that the felspars of this district are orthose or potash felspar, containing only small quantities of replacing soda.

"On the occasion when Dr. Apjohn made his communication, I find that Sir Robert Kane repeated his statement as to the nature of these granites, together with the grounds on which he rested it. 'The idea,' viz., that the predominant characters of the granite district of Dublin and Wicklow was the presence of soda felspars, 'was founded not merely on the results of the analysis of the waters read at the last meeting, and which in itself he did not consider very important, but was the result of a widely-spread series of observations, which, on another occasion, he hoped to be able to bring before the Academy.'—Vol. v. p. 382, February 28, 1853.

"Feeling, as I do, a great interest in this question, I confess I have for a long time looked forward with some anxiety for the production of these analyses; and I hope I may be allowed, on the part of the Academy, to express the hope, that at no distant day Sir Robert Kane will lay before the Academy what I am sure will be esteemed a most valuable communication. Independently of my wish to arrive at the settlement of a scientific question, I feel some anxiety on the subject for another reason, namely, my utter inability to reconcile Sir Robert Kane's statement, with regard to the results of his rock analyses, with what (at least to my own satisfaction) I think I have succeeded in proving. The granite of Dublin and Wicklow, as I have said, consists of three elements, quartz, mica, and felspar. Of these quartz, as is well known, contains no alkali, and may be therefore dismissed from our consideration. Mica contains both alkalies, but the potash always in great excess. Felspar, the third element, contains, as I have shown, both potash and soda, but the former always in great excess, in the ratio, namely, of 9:2. This being the case, I cannot in any way see how a rock, which is a mixture of these three constituents, should on analysis yield 'both potash and soda; but the latter, viz., soda, almost always so preponderant, as to lead to the conclusion that the potash should, in most cases, be considered to belong to the mica which the granite contained, and that the felspar was almost exclusively an albitic or soda felspar, containing only in some cases a small quantity of replacing potash."

Rev. Mr. Haughton stated, with reference to Mr. Galbraith's communication, that he had himself made a chemical examination of some specimens of mica from the Wicklow and Dublin granites, with reference to some remarkable differences in their optical properties, and that he had found in these micas, as Sir Robert Kane himself had observed, a preponderance of potash over soda, on an average of about 15 to 2. This result seemed to Mr. Haughton to render very difficult of satisfactory explanation the result of Sir R. Kane's unpublished analyses of granites, in which he found a great preponderance of soda; for if the micas contain potash to soda in the proportion of 15 to 2, and the felspar, as Mr. Galbraith had just demonstrated, contain potash to soda in the proportion of 9 to 2, Mr. Haughton confessed himself unable to understand how a rock made up of such minerals could contain a great preponderance of soda. He quite concurred in Mr. Galbraith's wish, that Sir R. Kane would favour the Academy with his promised analyses.

Dr. Apjohn remarked, that in his opinion Mr. Galbraith's analyses were conclusive as to the relative quantities of potash and soda in the Dublin and Wicklow felspars, and were quite coincident with the opinions which he had himself previously expressed upon this subject. He further observed, that he objected to the use of the terms orthose and albite, as distinguishing between potash and soda felspars, as both alkalies might and did occur in both minerals in varying proportions. The true distinction, in his opinion, between these minerals was crystallographic, the former always occurring in the fifth, and the latter in the sixth system.

Mr. Mallet mentioned a fact which had come under his observation, which confirmed in a remarkable manner the re-